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# AN ECOLOGICAL SURVEY OF THE PROPOSED MT. PLEASANT RESEARCH NATURAL AREA, PLUMAS NATIONAL FOREST, CALIFORNIA

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# INTRODUCTION

## Location and Principal Distinguishing Features:

The Mt. Pleasant candidate RNA covers about 1785 acres of primary red fir forest, mountain riparian, mountain chaparral, and diverse lake, bog, and meadow communities at the extreme northern end of the Sierra Nevada.

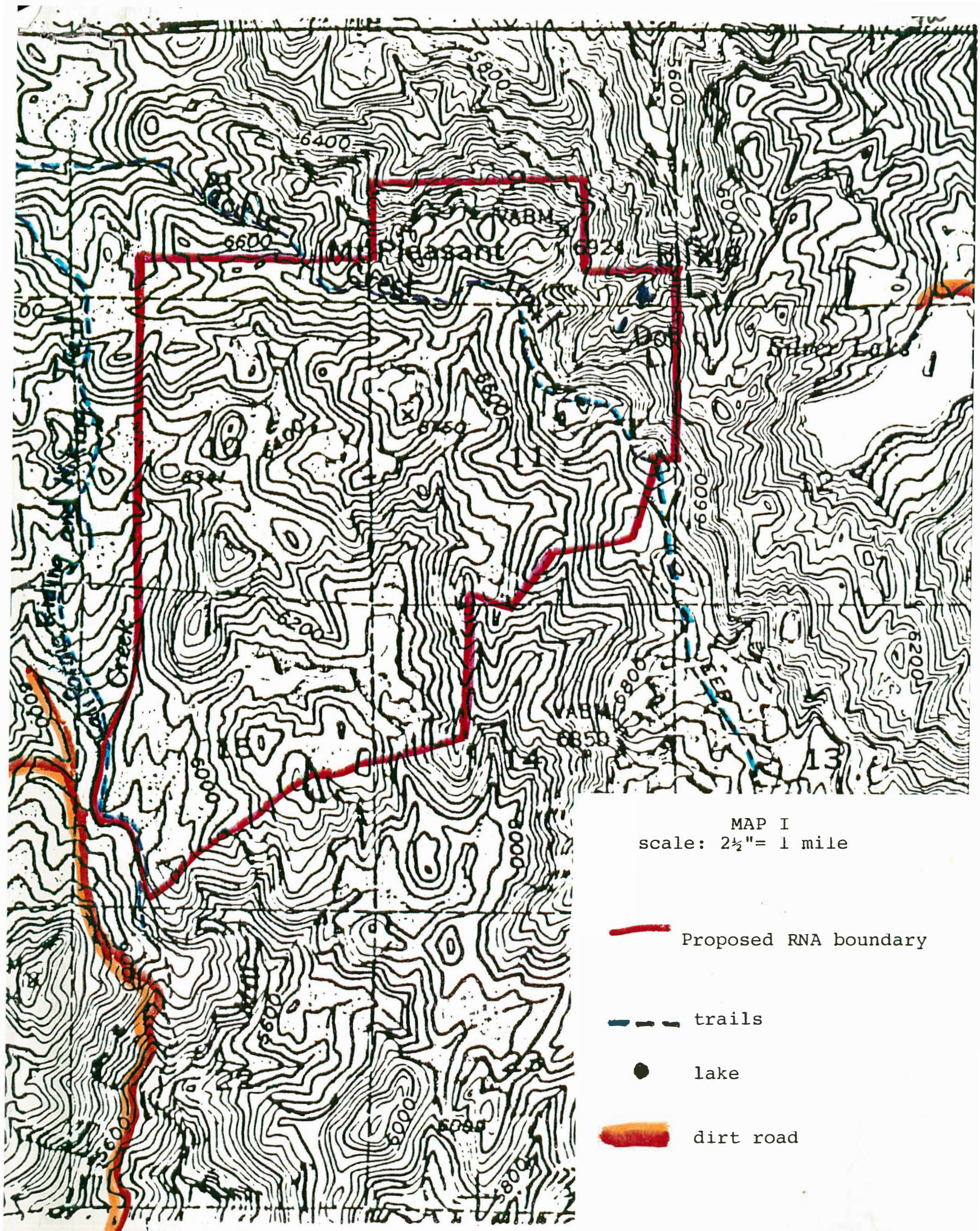
The proposed RNA is in Plumas National Forest, Plumas County about five miles due North of the resort area along the South shore of Bucks Lake. It lies within portions of sections 2,3,10, 11, 14, and 15 of Township 24 North and Range 7 East (see map 1). Elevations range from ca. 5910 ft. at the southwest corner to 7111 ft. atop Mt. Pleasant.

The area is most accessible from its southwestern corner where a dirt road leading from Bucks Lake Dam to Bald Eagle Mtn. passes West of the main branch of Mill Creek. An unmarked campsite just off this road along the West side of Mill Creek (ca. 100 yds. North of the Cape Lake outlet stream) offers a good base camp just across the creek from the proposed western boundary. From Quincy via the Quincy-Oroville Highway it is approximately a 27 mile drive to this campsite, all but the last seven miles being good two-lane road. Alternate access to the upper elevations of the area may be had from Three Lakes by taking Pipeline Rd. North from the outlet to Lower Bucks Lake to Three Lakes then using the Pacific Crest Trail and walking ca. three miles to the northwest corner of the area. Another possible access to the eastern face of Mt Pleasant is via the Silver Lake road which leaves the Quincy-Oroville Highway in Meadow Valley and ascends to Silver Lake campground. From there it is a ca. one mile cross country hike to Blixie Lake at the eastern boundary of the area.

The red fir forests of the Mt. Pleasant area are physiognomically diverse ranging from deep, dark groves of 175 ft. trees on sheltered benches, to open park-like forest with an understory of many herbs and shrubs on the valley slopes, to stunted 80 ft. tall ridge top stands. Unlike many regions within the red fir zone this area has abundant regeneration with trees in all size classes well represented. Within the approximately 1200 ft. elevation change, the red fir forest shifts from a mixture of red and white fir through a broad zone of almost pure red fir to a higher elevation type with western white pine and locally mountain hemlock as sub-dominants. Clinal shifts from valley bottom moist forest with admixtures of lodgepole pine to drier pure fir areas on upland slopes also add to the diversity of the local red fir forest.

The remarkable Drosera bogs along the West-central branch of Mill Creek and in other parts of the area are another significant attribute of this candidate RNA. These bogs house a variety of meadow and aquatic plants including several that are considered rare or have not been recorded previously from this portion of California. Bogs are rare in the Sierra Nevada (Rundel et. al., 1977). Because this small area contains at least 10 distinct populations of Drosera rotundifolia and associated bog species it is indeed unique and deserves to be formally protected.

The glaciated Northeastern escarpment of Mt. Pleasant is another area of botanical interest. Nestled within the crevices and shady granite overhangs are a number of subalpine species, some normally occur at substantially higher elevations and some are quite rare or at their northern extremites of range in the Sierra Nevada.




MAP I
scale: 2½"= 1 mile

Proposed RNA boundary

trails

lake

dirt road

History of Scientific Interest:

Although the area was mapped by the V.T.M. survey (map on file at PSW Berkeley) in 1934, the details of its flora were not recognized until 1975 when a team of botanists under contract by the Forest Service made a survey of the vascular plants of the Northeastern Bucks Lake Basin (Pass et. al.,1975). This report surveyed in detail local populations of all plants considered rare and/or endangered in the CNPS list (Powell,1974). After the survey the authors singled out the Mt. Pleasant area as a particularly important site because of its fine red fir stands and the high number of bogs with Drosera and other rare species. They wrote to the Plumas District Ranger in November 1975 and proposed that the area be considered for RNA status. In Fall 1978 the reconnaissance report was undertaken (McDonald and Church, 1979) and after this report was reviewed by the PSW RNA committee in May 1980 the Regional Forester sent the recommendation to initiate this current report.

## JUSTIFICATION

Ecological Comparison With Other Red Fir RNA's:

The District Ranger in the original proposal to PSW was quoted as saying he would first like to know how the Mt.Pleasant red fir forest compared to other areas of the same forest type in the region before committing it as an RNA. To date no other Forest Service RNA's with substantial red fir forest have been established in California. However, four other candidate RNA's in the Sierra Nevada contain sizable tracts of red fir forest (SAF type 207). How does this area compare to these potential preserves?

The closest candidate RNA with any red fir forest is in Tahoe National Forest on Babbitt Pk. (Talley 1977b). This area is in the

rain shadow of the main Sierra Crest, ca. 15 miles Northeast of Truckee, and receives only ca. 30-40" of precipitation per year. The primary vegetation types include sagebrush scrub, mtn. mahogany woodland, aspen forest, Washoe pine forest, western white pine forest, white fir forest, and red fir forest. The red fir forests of Babbitt Pk. are small (ca. 60 ha) and restricted to North aspects. Only 20 ha of this is undisturbed old growth and this stand is mixed with Pinus monticola and Abies concolor. At Babbitt Pk. the Washoe pine forest is a much more important and scientifically significant forest type. The Abies magnifica community is not well represented.

About three miles South of Norden in Tahoe National Forest is the Onion Creek candidate RNA. This area of 419 ha contains large stands of both red and white fir. About 147 ha of this area is red fir forest (Talley, 1977a). This extensive red fir forest predominates on North slopes above 2000 m. On South and West slopes above 2000m A. magnifica is replaced by A. concolor except on gentle slopes and within sheltered cold air drainage canyons. There is not the uniform coverage by A. magnifica on South and West slopes that occurs in the Mt. Pleasant area. There are, however, large areas of North slopes where A. magnifica is overwhelmingly dominant. Unlike the Mt. Pleasant site Pinus monticola and A. concolor are more widely dispersed throughout the stands and because of a greater elevational range Tsuga mertensiana occurs commonly at high elevation sites. Annual precipitation is slightly lower at Onion Creek averaging ca. 60-70", but the average April 1 snowpack is apparently slightly higher (ca 100" than the known average for the lowest elevation at Mt. Pleasant (Kahrl, 1979). The rock type is volcanic (Miocene and Pliocene pyroclastics), not granitic, and wet meadows and alder thickets play a much less important role in the vegetation with no bogs and associated bog species.

Lodgepole pine is also absent from Onion Creek.

From the age class-climate correlations calculated by Talley for Onion Creek it appears that there is a shifting of dominance in establishment between red and white fir. The latter spreading more successfully in warmer and wetter periods (50-100 yrs. ago) and the former spreading during cold moist periods (350-400 and 200-250 yrs. ago) and not reproducing during periods of relative drought (1675-1725 and 1775-1860). Apparently the higher precipitation and slightly cooler winters of the Mt. Pleasant region have prevented white fir from assuming dominance in any portion of the study area. Pinus monticola also appears to be more successful at Onion Cr. because of a warm-dry trend, according to Talley. This also supports the idea of a relatively continual moist-cool regime at Mt. Pleasant because most P. monticola occurs on high exposed ridges where much snow could be swept off during the winter.

Further South on the Stanislaus National Forest is the Bourland Meadow candidate RNA. 57% of this area of 406 ha is covered by red fir, with some lodgepole and aspen forest, meadow, and mountain chaparra The large red fir stands at Bourland Meadow differ from the Mt. Pleasant stands because they contain much higher densities of other species. Abies concolor, Pinus contorta var Murrayana and P. Jeffreyi make up about 20% of the stands of red fir forest. The overall density of trees at Bourland Meadow is generally lower than obtained for Mt. Pleasant and a large number of red fir stands throughout the Sierra (Oosting and Billings, 1943). The Bourland meadow area does have extensive wet meadows (albeit overgrazed), lodgepole pine forest, and mountain chaparral similar to the Mt. Pleasant area although no rare bog or rock outcrop species were reported by Talley (1976). The annual precipitation for Bourland Meadow is estimated as being 60-70" with ca. 100" of snow on April 1 (Kahrl, 1979). The rock type under-

lying the fir forest is primarily volcanic although granite underlies a small area of mtn. chaparral and mixed red fir, western white pine, and lodgepole forest.

The southernmost red fir candidate RNA is at Teakettle Creek on the Sierra National Forest (Griffin, 1975). This 1250 acre area contains sizable red fir groves (16% of area) and also large areas of white fir-red fir forest (24%), and red fir forest-brush (11%) as well as mixed conifer forest, white fir forest, subalpine fir-pine woodland, Jeffrey pine woodland, and both dry and wet meadow habitats. The average annual precipitation is 50-60" with ca. 75-100" of snow on April 1 (Karhl, 1979). The red fir stands at Teakettle Cr. are represented by pure dense old growth, dense mixed red and white fir, open red fir-brushland, and open, rocky Jeffrey pine-red fir ridge-top woodland, therefore showing a comparable range of subtypes to the Mt. Pleasant area. The parent material is quartzite throughout. The greatest difference between the two areas lies in the lower precipitation and lack of bogs at Teakettle Cr. There is also a higher admixture of A. concolor on the "good examples" of red fir stands than at Mt. Pleasant and P. monticola is rare even at highest elevations. Griffin does not give details on the slope exposure of the red fir stand but it appears from his vegetation map that red fir forest is more restricted to North slopes than at Mt. Pleasant.

The candidate RNA at Mt. Pleasant is thus unique with regard to the other red fir areas under consideration as RNA's for the following readily apparent reasons:

1) Red fir is the overwhelmingly dominant tree species throughout.
2) Red fir is represented in many different cover and stand types including South and West aspects which are rare or absent at other sites.
3) The red fir zone at Mt. Pleasant receives the highest annual

precipitation of any of these sites and apparently is cool enough to support continual reestablishment of red fir on all slope aspects where soil is well enough developed.

4) Mt. Pleasant is the only area with a unique bog flora.

5) Mt. Pleasant is the only red fir area considered for protection that is found largely on granite, the most widespread rock type in the higher Sierra Nevada.

As Griffin (1975) has previously mentioned, because the red fir forest is an important forest type covering 5½° of latitude, there should be several examples of this community protected under RNA status. All of the previously mentioned candidate RNA's have unique values and exemplify the wide range of situations over which red fir can occur.

Additional Important Features of the Local Red Fir Forest:

1) Broad elevational range:

The Mt. Pleasant red fir forests represent a fine example of the Northern Sierra variety of SAF type 207. Within the boundaries the red fir forest ranges from near its local low elevation limit with a moderate admixture of A. concolor on some sites (just South of the area an elevation drop of only 200 ft. initiates the decline of A. magnifica and substantial increase in A. concolor, P. lambertiana, P. jeffreyi, and Calocedrus decurrens) to nearly the highest elevation reached in the region. Mt. Pleasant is only ca. 60 ft. lower than the highest summit in the Bucks Lake area and mixed with red fir near its summit are P. monticola and Tsuga mertensiana, typical constituents of higher elevation red fir forests in other parts of the Sierra. Thus, nearly the entire local elevational range of red fir is represented.

2) Fast growth rates on Southwest exposures:

The largest part of the local fir forest (ca. 70%) grows on moderate to gently sloping southwestern exposures. Red fir at similar elevations in other parts of the Sierra will usually not form forests on South or West exposures because of the rapid rate of melt off and blow off of snow. However, due to high precipitation, good forests do exist at Mt. Pleasant on these exposures. Talley (1977a&b) has found that red firs that can survive on gentle Southwest slopes grow faster than individuals on all other exposures. This suggests that the area may house one of the most quickly maturing and reproducing red fir forests in the Sierra. A small amount of data collected support this conclusion (see vegetation section). Because the red fir forest is generally considered to be a very slowly developing forest type (Oosting and Billings, 1943) studies of growth rates and conditions here could be very illuminating to silvaculturalists.

3) A different mode of red fir regeneration?:

Because of its apparent rapid growth, high precipitation and generally open nature the local fir forest may have different types of regeneration tactics than most red fir areas. Preliminary observations indicate a higher percentage of uneven aged stands with a more regular seedling production rate than has been suggested for most red fir forests (see Appendix 3). A more careful study of reproduction and regeneration parameters in this forest may show significant differences from the standard view of A. magnifica regeneration (Rundel et. al.1977 and lead to a better practical understanding of the ecology of this species.

4) Geographic location in A. magnifica-A. m. var. shastensis cline:

The fact that the exserted-bract Shasta red fir occurs as the dominant variety 30 miles North on Mt. Lassen and throughout the South

Cascades to Crater Lake, but appears to be totally absent from the Mt. Pleasant area is intriguing. In Ustin's (1976) study of geographic variation of the species in the Central and Southern Sierra she found a gradual cline in the degree of cone bract exsertedness from North to South. Ten random mature cones were measured from the local trees for an average scale to bract ratio of 0.72. This corresponds closely to the ratios of the northernmost populations studied by Ustin (just North of Lake Tahoe) which were 0.73 and 0.77 and appears to continue the clinal trend to smaller ratios moving North. This suggests that there is either a very steep cline or a sharp zone of demarcation, perhaps at a geographical boundary such as the Feather River Canyon, between the Shasta and Sierra red fir. The relationships between the southern Sierra exserted bract red fir (which Ustin feels is not akin to Shasta red fir), A. magnifica, and A. m. var. shastensis could possibly be clarified with further study at Mt. Pleasant and in other red fir stands of the far northern Sierra and adjacent southern Cascades.

The Rare Sierra Bog Flora:

The fact that within this small area there are 10 distinct populations of the very rare Drosera rotundifolia and several populations of such other recognized rare bog species as Carex angustior, C. limosa, Menyanthes trifoliata, Poa palustris, and Sparganium minimum make this an extremely unique and important botanical area. Huge areas of the Sierra Nevada exist without so much as a single population of some of these species. For example Gladys Smith (1973) lists only one Drosera and C. angustior population, two C. limosa and P. palustris populations, and four S. minimum populations for the entire Tahoe Basin. Gillett et. al. (1961) know of only two collections in Lassen National Park for

FIGURE 1: Drosera rotundifolia in typical habitat

FIGURE 2: Menyanthes trifoliata with Carex limosa in submerged bog. July 14, 1981

Drosera and S. minimum, one for Poa palustris, and none for the other two species. Bogs are the most sensitive of all the Sierra wet habitats (Rundel et. al., 1977) and many have been destroyed or severely damaged. The opportunity to protect these rare, but often extremely widely distributed species should be easily taken.

The Rare Plants of the Northeast Escarpment:

The cold crevices and exposed rocks of the steep Northeast face of the Mt. Pleasant-Spanish Pk. ridge support several interesting plant species that are rare or not otherwise known from the Bucks Lake area.

Primula suffrutescens , the Sierra Primrose, is a rare species in the Northern and Central Sierra (Smith, 1973) occurring in scattered colonies usually at substantially higher elevations. Perhaps its northernmost outpost in the Sierra-Cascade chain (excluding the isolated populations in the Klamath Mtns.) is the previously unreported colony on the North face of Mt.Pleasant.

Athyrium alpestre var. americanum, the Alpine Lady Fern, is locally common in the shady, moist talus on the Northeast escarpment. This species is usually found above 8000 ft in the Northern Sierra and South Cascades (Smith, 1973; and Gillett et. al.,1961).

Rhamnus alnifolia, the Alder-leaved Coffeeberry, only occurs in California in the Northern Sierra from Placer to Plumas County (Smith, 1973). The individuals growing above Dot Lake may be the Northernmost California population.

Heuchera rubescens var. glandulosa, the Pink Alum Root, forms beautiful colonies in the shady crevices and may represent the northernmost populations of this Northern Sierra endemic.

Sedum obtusatum ssp. boreale, a variety of the Sierra Stonecrop is known from only three locations in the Southern Cascades and North

FIGURE 3: Primula suffrutescens on upper North slope of Mt. Pleasant

FIGURE 4: The Northeast escarpment from the East flank of Mt. Pleasant to Spanish Pk. Dot and Blixie Lake Basin in forground.

Sierra (Clausen,1975). It is a fairly common plant on exposed granite slabs in the Blixie and Dot Lake basin.

Two other recognized rare California species (Powell,1974) also occur on the dry decomposed granite benches of the Northeastern escarpment as well as locally in similar dry habitats such as dry meadows and mtn. chaparral. These are Castilleja payneae and Penstemon neotericus , both endemics of Northeast California and adjacent Oregon.

Zoological Justifications:

The Mt. Pleasant area, because of its mosaic of dense and open fir forests, numerous meadows, streams, lakes, brushlands, and rock outcrops supports a great diversity of animals for this elevation (see Appendix 2 for list of local vertebrates). Perhaps the most interesting residents of the area are two spectacular predatory animals; the Great Gray Owl and the Mountain Lion.

Certainly the rarest breeding owl in Northern California, the Great Gray is an impressive bird with a huge,puffy "hornless"head and long wings and tail. A pair of these birds were noted several nights in both early and late summer along the lower reaches of Mill Creek and its Westcentral branch. At dusk these birds were heard giving a repeated pheasant-like squawk. Once when one flew North over our campsite to join the other at the edge of a meadow they were both heard bill-clapping and giving deep hoots.

In California this owl is only known to breed in a few locations in the Central and Northern Sierra. It regularly chooses dense red or white fir forests with adjacent lodgepole pine-surrounded meadows in which the bird hunts meadow and deer mice. Obviously this habitat is well represented locally. However, these birds by no means occur wherever this habitat exists. Yosemite National Park probably boasts

the greatest density of these birds in the state and the park only contains 3-4 pairs (Small, 1974)! Thus, the finding of an apparent resident pair here is quite unique and another reason to maintain the area in its pristine state.

Mountain Lions, though not particularly rare in much of montane California are not common in the higher elevations of the Sierra (California Fish and Game, pers. com. 1980). The fact that on both occasions of our visits we found large (ca. 4" long) fresh tracks along a length of the California Riding and Hiking Trail within the area and in the wet sand along Mill Cr. is noteworthy and suggests that a large deer population is supporting the local lion(s).

## PHYSICAL FEATURES

Topography:

A transect from the lowest elevations along Mill Creek over the summit of Mt. Pleasant resembles a miniature transect from West to East over the Sierra Nevada. The western slopes rise gradually, ascending only about 1200 ft. in ca. 2¼ miles, but the eastern escarpment plunges down 1200 ft. in less than ½ mile.

The southwestern slopes coming off of the Mt. Pleasant-Spanish Pk. crest are drained by the seven branches of Mill Creek. The main branch and the West-central branch are the two principal streams in the RNA. Both of these streams are of about equal volume and are fed by numerous permanent springs. The valleys that house these two branches of Mill Creek are not deep (ca. 500 ft. maximum) and the relatively gentle topography makes for easy traversing from one drainage to the next. Numerous low saddles exist along the dividing ridges and these are often covered with meadow and mountain riparian vegetation or well developed fir forest. These low saddles probably represent worn joints

FIGURE 5

Dot and Blixie Lakes, bench meadow and mesophytic crevice species in foreground.

in the granite and because of the heavy precipitation in the area, often accumulate moisture from the drainage of the surrounding shallower soil and exposed boulders and slabs.

In contrast, the steep, exposed granite slabs of the Northeast escarpment are sparsely vegetated and are reminiscent of many eastern crest areas along the Northern Sierra. Vertical cirque walls at the top of the valley above Dot and Blixie Lakes are from 50-150 ft. high and drop down only slightly less steeply to the two small lakes (Fig. 5). The North slope of Mt. Pleasant has also been cut by glaciers and exhibits vertical granite cliffs dropping down to sparsely vegetated granite benches along the proposed northern boundary.

Geology:

The Mt. Pleasant area is very close to the Northern terminus of the Sierra Nevada. In his map of the Northern Sierra, Durrell (1966) draws the northern boundary of the main Sierra Crest about six to seven miles northwest of Mt. Pleasant. This is just North of the North Fork of the Feather River, where Cascadian volcanic rocks of Pliocene age take over. Although the Grizzly and Diamond Mountains Northeast of Mt. Pleasant are often considered the northernmost extention of the Sierra, their structure is actually more similar to the Basin and Range Mountains and they might more properly be included with them (Durrell,1966).

The RNA is thus at the northern tip of the 400 mile long Sierra Crest and is underlain by the Northwesternmost granitic pluton in the range. This pluton has been Potassium-Argon dated at ca. 130 m.y. (Hill, 1975), about the same age as the Shasta Bally Pluton near Redding ca. 60 miles Northwest (Alt & Hyndman, 1975). Current theory strongly suggests that the Klamath and Sierra Provinces were continuous

until they split apart in the early Cretaceous. Therefore, the Mt. Pleasant granite may actually be analogous to the Shasta Bally Pluton, which is at the proper position (at the far Southeastern edge of the Klamath Province) to have a near perfect match-up if the two ranges were shifted back to their theoretical pre-Cretaceous position.

The rocks of the Mt. Pleasant area are overwhelmingly of one type: granite. The only other significant rock identified in the RNA was andesite, which occurs locally as dikes in the granite particularly at the higher elevations as on the summit of Mt. Pleasant. These dikes are from 6" to 2ft. wide and are darker gray and much finer-grained than the surrounding granite with scattered inbedded hornblende crystals. Some dikes have a thin green coating of small olivine crystals.

The composition of the granite appears to range from quartz diorite to granodiorite. Unlike many other locations in the Sierra the local granite contains few mafic inclusions (smaller bodies of darker granitic rock enclosed within the lighter surrounding rock). However, the granite does have its share of mafic minerals, particularly hornblende (some crystals as long as ½ inch). Biotite flakes glisten in all the streams and occasionally nearly pure milky quartz veins an inch or two thick lace the granite outcrops.

According to Bateman and Wahrhaftig (1966) this pluton is similar to other Western Sierra granite in that it is more mafic than the younger Eastern Sierra plutons indicating a magma origin closer to the sima or thinner sialic layer nearer the old continental border.

As in much of the granitic portions of the Sierra, jointing plays an important part in the shaping of the topography. These joints have eroded away into conspicuous chasms and rifts including those which hold Dot Lake and the isolated population of Primula suffrutescens.

just below the summit of Mt. Pleasant. Other conspicuous joints channel segments of the main branch of Mill Cr. along portions of the western boundary. Throughout the area the joints running Northeast are generally more conspicuous than those running Southeast. However, the benches on the eastern escarpment are formed from weathering of the NW-SE trending joints in this area.

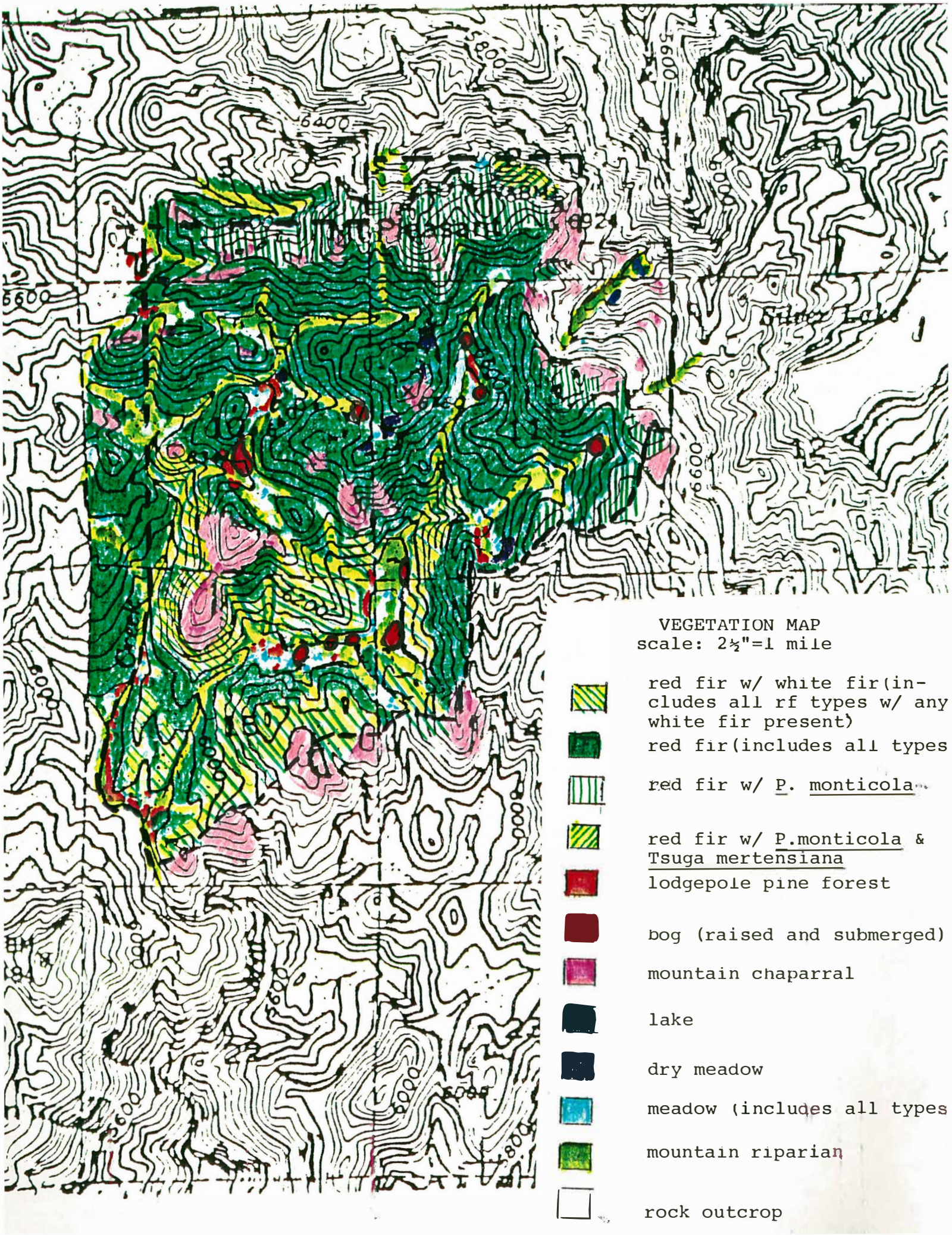
The eastern face of the Mt. Pleasant-Spanish Pk. ridge was heavily glaciated during the Pleistocene. Evidence within the area is most prominent in the basin which holds Dot and Blixie Lakes. This includes steep cirque walls, glacially polished granite slabs, and morainal deposits below Blixie Lake. Dot Lake was undoubtedly formed when a glacier scoured out a large joint or series of closely spaced joints. Glaciers evidently extended down this and other nearby drainages to ca. 5000 ft. elevation as evidenced by lateral moraine deposits.

The soils of the area vary widely in depth from bedrock on the eastern escarpment and many slopes and ridges to deep black organic meadow soil. The soils underlying the best developed red fir groves on the benches and saddles are several feet deep and are primarily decomposed granite with a fair amount of organic material in the A horizon.

Climate:[1]

The Mt. Pleasant area is within a region of high precipitation in the Sierra Nevada. The area with the highest mean annual precipitation reported for the entire mountain range (ca. 96") is only ca. 10 miles South. The estimated annual ppt. for the Mt. Pleasant area ranges from 80-90" with about 90% falling as snow at the higher elevations and perhaps 70% at the lowest elevations.

[1]Data from Karhl (1979) and Snow Surveys Branch, Cal. Dept. Water Resources, personal communication October 1981.




VEGETATION MAP
scale: 2½"=1 mile

- red fir w/ white fir (includes all rf types w/ any white fir present)
- red fir (includes all types
- red fir w/ P. monticola
- red fir w/ P. monticola & Tsuga mertensiana
- lodgepole pine forest
- bog (raised and submerged)
- mountain chaparral
- lake
- dry meadow
- meadow (includes all types
- mountain riparian
- rock outcrop

The average April 1 snow depth from the Mill Cr. Flat snow course at 5910 ft on the western boundary is about 95", which is substantially greater than the 87" annual April 1 average at Donner Summit at 7000 ft. near one of the highest snowfall areas in the Sierra. There is reason to believe that on the upper western slopes of Mt. Pleasant snow reaches very great depths for long periods during the winter. The yellow-green Letharia lichen which characteristically coats the trunks of the mature red firs does not grow below the normal winter snow pack (Rundel et. al., 1977). At many local high elevation sites this lichen begins its growth from 12-14 ft. above the ground, suggesting snow depths of at least 144" for much of the winter. As in most of Northern California summer precipitation is negligible except for rare heavy thundershowers.

Undoubtedly this high annual precipitation is reflected by the dominance on most exposures, great size, and general good health of the red fir forest and the high number of permanent bogs, springs, and streams within the confines of this small area.

## VEGETATION

### Mountain Riparian:

This hydrophilic association is dependent on year-round moisture and occurs along permanent streams, rivulets, or springs. It differs from other local hydrophilic associations in that it is dominated by woody species. The most characteristic plant is Mountain Alder, Alnus tenuifolia. This species usually far surpasses all others in importance except locally where two species of willows, Salix orestera or S. caudata are dominant. Other less important woody plants are; Sorbus californicus, Cornus stolonifera, Sambucus microbotrys, Spiraea douglasii, Vaccinium occidentale, Lonicera conjugalis, Kalmia polifoli

ACREAGE OF VEGETATION TYPES

| | ACREAGE | PERCENT |
|---|---|---|
| Riparian | 179.5 | 10.0 |
| Bog | 9.8 | 0.5 |
| Meadow | 68.7 | 3.8 |
| Lodgepole | 19 | 1.1 |
| Red Fir | 1262 | 70.6 |
| Mountain Chaparral | 100.5 | 5.6 |
| Dry Meadow | 23 | 1.3 |
| Rock Outcrop | 125 | 7.0 |
| TOTALS | 1787.5 | 100.0 |

var. microphylla, and Ledum glandulosum var. californicum.

These shrubs and small trees often form dense thickets several meters wide on either side of streams. Within these thickets grow a number of herbaceous species in common with wet and moist meadows, but there is a core of species which are most characteristic of this wet but shady habitat including; Aconitum columbianum, Athyrium felix-femina, Aquilegia formosa, Boykinia major, Circaea alpina , Cystoperis fragilis, Epilobium angustifolium, Galium trifidum, Lilium pardalinum, Mimulus lewisii, Mitella breweri, Polygonum phytolaccifolium, Pucinella pauciflora, Thalictrum fendleri, and Viola glabella.

In certain streamside areas the shrub cover is diminished allowing more sunlight into the ground layer (this is often the result of cattle disturbance). Here in the saturated sand and mud may be found additional species such as Mimulus moschatus, Polygonum douglasii, P. kelloggii, Gnaphalium palustre, Rorippa curvisiliqua, Stachys rigida, and Montia Chamissoi which appear to require more sun and disturbed, open substrate than other hydrophilic herbs.

A distinct subtype of riparian vegetation occurs on the Northeast escarpment in moist talus and along rivulets leading down to Blixie and Silver Lakes. This type is dominated in the most part by Salix orestra, a gray-green, silky-leaved willow. Mixed with the willow are pockets of Rhamnus alnifolia, Populus tremuloides, Sorbus californicus, Spiraea douglasii, and Acer glabrum var. torreyi. The herbs Mimulus lewisii, Castilleja miniata, and Athyrium alpestre var. americanum are particularly abundant among the shrubs in these moist talus areas.

Bog Vegetation:

Bogs occur in both drainages of Mill Cr. within the study area, but are most numerous along the Westcentral branch. They are

characterized by a Sphagnum moss substrate often several feet thick. This substrate is thoroughly saturated and may be both underlain and overlain by several inches of water. This moss layer does "quake" to varying degrees when stepped on.

There are two subtypes of bogs in the area, each has different species associated with them. These are the submerged and the raised bogs. The primary environmental factor separating these subtypes appears to be the slope and the amount of standing water present through the growing season.

The submerged bog occurs in valley bottoms and is characterized by standing water usually a few inches deep through the growing season. Many of the species associated with this type are emergent aquatics such as Menyanthes trifoliata, Sparganium minimum, Heleocharis aciaularj var. bella, H. montividensis, Carex rostrata, and C. limosa. However, there are also floating leaved anchored hydrophytes such as Potamogeton natans and Nuphar polysepalum in the deepest water (6-18"). The Sphagnum is often dark olive green and covered with a layer of ooze and during the late summer portions may become exposed. However,the moss itself is always saturated. The overall aspect of this bog type is more open than the next subtype. There are often patches of bog that are largely unvegetated except for the Sphagnum mat.

The raised bog may occur as a border around the submerged subtype or it may occur alone at the center of wet meadows or at the edges of riparian growth. Wherever it exists this bog type is characterized by year-round seepage of water and a slight slope. Where it occurs as a border this type may represent a successional sere, the next step up from the submerged bog, or it may simply represent a localized super-saturated wet meadow.

Species associated with this subtype include a bright yellow-greer

FIGURE 6

Submerged bog with Carex limosa dominant showing interfingerings of successional raised bog with Polygonum bistortoides and associated species

spongy moss (Sphagnum sp.?), Drosera rotundifolia, Mimulus primuloides var. pilosellus, Castilleja lemmonii, Pedicularis attolens, Aster alpigenus ssp. andersonii, Carex angustior, C. gymnoclada, C. senta, Camassia leichtlinnii ssp. suksdorfii, Epilobium brevistylum, E. oregonense, Poa palustris, Viola macloskeyi, and Polygonum bistortoides. Frequently interspersed with these herbs are scattered ericaceous shrubs particularly Vaccinium occidentale and Kalmia polifolia var. macrophylla.

The bogs in the study area do not appear to have been derived from long-persisting glacial lakes. There is no evidence of glaciation on the Mill Creek side of the RNA. It is likely that these bogs formed from blockage of streams by debris and subsequent siltation. The present stream courses are always at a slightly lower level than the bogs, indicating that seepage from surrounding slopes (and not the streams themselves) is their primary source of water.

Meadow Vegetation:

Meadows are widespread in the RNA and vary from narrow "stringer" types along edges of riparian growth and at seeps, to broad valley bottom types up to 300m wide. The meadows all differ somewhat in their degree of wetness and their species composition, but they may be conveniently divided into two major subtypes: wet and moist. Both types overlap to a fair degree in their species composition and the following is a list of typical Mt. Pleasant meadow species:

Barbarea orthoceras
Caltha howellii
Carex jonseii
Carex nervina
Carex senta
Deschampsia danthonoides
Dodecatheon alpinum ssp. majus
Epilobium hornemanii
Epilobium glandulosum
Epilobium lactiflorum
Galium biflorum
Hypericum anagaloides
Juncus nevadensis
Juncus parryi
Lupinus polyphyllus ssp. superbus
Luzula comosa
Mimulus guttatus
Mimulus primuloides
Muhlenbergia filiformis
Perideridia bolanderi
Poa hansenii
Ranunculus alismaefolius var. alismellus
Saxifraga aprica

Scirpus congdonii
Senecio triangularis
Trifolium longipes
Veronica serpyllifolia var.humifusa

The wet meadow remains at least moist on the surface even at the end of the summer. It usually occurs around springs or small rivulets which often flow through larger moist meadows or patches of riparian growth. Wet meadows may also occur adjacent to bogs and there represent a successional trend to drier, less saturated conditions. Wet meadows may have moss species as a component, but never species of Sphagnum and they are never truly spongy or quaking. Wet meadow soil is very rich in organic matter, but also contains a small amount of decomposed granite or sand. Its color is usually black. In addition to the general meadow list species characteristic of this subtype include: Cardamine breweri, Deschampsia caespitosa, Glyceria elata, Habenaria dilatata var. leucostachys, H. sparsiflora, Luzula subcongesta, Saxifraga oregana, Sphenosciadium capitellatum, and Viola adunca.

Moist meadows are more extensive than the previous type and may be distinguished from wet meadows by the fact that they are only wet for the early part of the summer, proceeding to dry out almost completely by summer's end. Moist meadows frequently occur in swales, small valleys, or at the edge of narrow riparian strips. They regularly intermingle with adjacent mesic red fir or lodgepole forest and are thus often just a successional stage away from being dominated by coniferous vegetation. Some moist meadows in the proposed RNA contain young saplings of lodgepole pine and red fir. In others there are stumps and snags of old trees suggesting fluctuations in moisture (and perhaps browsing pressure) in the recent past. The soil has a much higher percentage of decomposed granite than wet meadows and often only a relatively thin layer of organic matter. Most moist meadows have a greater average slope than wet types and may occur

on slopes as great as 30°. Moist meadows often appear to have developed adjacent to a source of permanent moisture, but do not have a constant water supply percolating through them. Because of their frequent occurrence in swales and valley bottoms, nighttime dew condensation may be quite heavy and provide important additional moisture at least during the first half of the summer. The following species are characteristic of moist meadows:

Achillea lanulosa
Agrostis exarata
Aster elatus
Brodiaea lutea var. analina
Bromus orcuttianus
Calochortus nudus
Delphinium depauperatum
Deschampsia danthonoides
Erythronium purpurascens
Gilia capillaris
Horkelia fusca
Lewisia nevadensis
Ligusticum grayi
Lewisia triphylla
Microseris nutans
Microsteris gracilis
Mimulus breweri
Penstemon oreocharis
Perideridia parishii
Potentilla glandulosa ssp. nevadensi
Rumex acetosella
Veratrum californicum

A particular subtype of moist meadow occurs on and around moist benches and crevices on the Northeast escarpment. Here the soil may be saturated during spring and early summer due to funneling of snow melt off of the granite outcrops and into the eroded joints. Because of its higher altitude and colder North exposure a number of characteristically high elevation species mingle with the more typical local residents of this habitat. They include:

Agrostis variabilis
Arnica diversifolia
Aster campestris var.bloomeri
Athyrium alpestre var. americanum
Calamagrostis canadensis
Carex spectabilis
Luzula divaricata
Phyllodoce breweri
Poa hansenii
Poa epilis
Phacelia procera
Potentilla drummondii
Saxifraga bryophora
Saxifraga punctata ssp. arguta

Lodgepole Pine Forest:

Lodgepole pine (SAF type 218) forms narrow border groves along the edges of many of the larger meadows and along the lower reaches of Mill Creek within the study area. The tree appears to be closely tied to the moist conditions and cold air drainage associated

with these areas and only sporadically occurs on the upland slopes, and there never even as a local dominant. The individuals along lower Mill Creek may be large (several trees had dbh's over 45" and heights of over 135 ft.). This area appears to have been dominated by Pinus contorta var. murrayana for many years and there is healthy regeneration in several age classes. Sapling growth in the area is apparently slow, however (two trees with 3½" diameter at 2 ft. had ages of 67 and 74 years). The trees bordering meadows are generally smaller and there are localized areas of dead snags suggesting a water table fluctuation (perhaps with accompanying waves of needle-miner infestations).

The understory of the lodgepole groves reflects the moist conditions and may vary from typical meadow species to more shade-tolerant mesic herbs depending on the moisture and the closure of the lodgepole canopy. Meadow shrubs such as Vaccinium occidentale, Spiraea douglasii, Kalmia polifolia, and Alnus tenuifolia often occur in the understory of very moist lodgepole forest along with typical meadow species such as Scirpus congdoni , Carex spp., Viola spp., Caltha howellii, Aster spp., Mimulus primuloides, Hypericum anagaloides, Agrostis exarata, Deschampsia elongata, etc. In the shadier conditions along Mill Cr. other species such as Erythronium purpurescens, Pyrola secunda, Mitella breweri, Ligusticum grayi, Pedicularis racemosa, and Lupinus polyphyllus ssp. superbus occur as common understory members.

Red Fir Forest:

Red fir forest (SAF type 207) covers over 90% of the forested portion of the RNA. It is the only major commercial forest type in the area and occurs on nearly all slope aspects at all elevations provided the soil is deep enough for growth.

In order to quantitatively describe the local red fir forest 15 20x50 m (0.1ha) plots were set up on September 1,2, and 3 at "typical" sites within the lower (plots 6-10), middle (plots 11-15), and higher (plots 1-5) elevations of the area. These plots were not chosen to represent optimal growth (as in Griffin, 1975), but to typify a variety of exposures and cover representative of the RNA as a whole (i.e. more southerly exposure plots were chosen because this is the predominant aspect in the area). On each of the plots the following information was noted: aspect, steepness of slope, dbh of all trees 6ft and higher, height of all trees greater than 6ft. (measured with range-finder), number of tree seedlings and saplings under 6ft., presence of all species of herbs and shrubs, and average winter snow depth as measured from the height of lichen growth above ground level on five mature trees.

Tables 1 through 4 summarize the data, for additional information see Appendix 3. In relation to other red fir studies (Talley, 1976, 1977a, 1977b; Griffin, 1975; Oosting and Billings, 1943) the Mt. Pleasant forests compare favorably. Mean basal area for the Mt. Pleasant plots is 426.37 $ft^2$/acre (range 137.28-824.93), which compares closely to Griffin's average of 497 $ft^2$/acre (313-734). Oosting and Billings' plots ranged from 341 to 516 $ft^2$/acre. Talley found an avera of ca 320.6 $ft^2$/acre (converted from metric) with a range of 164 to 1211 $ft^2$/acre at Onion Creek, with Babbitt Pk. plots averaging ca 182.6, and Bourland Meadow stands varying between 133.6 and 356.3$ft^2$/acre.

Although the V.T.M. survey shows only a blanket of pure red fir forest present throughout most of the study area, there is some variability in this cover which warrants further description. We have recognized three major subtypes which have fairly constant

TABLE 1
TREE DENSITY PER 0.1HA

| Plot | A.mag. | A.con. | P.mon. | P.lam. | P.c.mu. | T.mer. | TOTAL |
|---|---|---|---|---|---|---|---|
| 1 | 30 | | | | | | 30 |
| 2 | 28 | | 2 | | | | 30 |
| 3 | 8 | | 6 | | | 6 | 20 |
| 4 | 18 | | 3 | | | | 21 |
| 5 | 16 | | 4 | | | | 20 |
| 6 | 25 | 1 | | | 21 | | 47 |
| 7 | 41 | | | | | | 41 |
| 8 | 17 | 9 | | | | | 28 |
| 9 | 31 | 26 | | 1 | | | 58 |
| 10 | 52 | | | | 1 | | 53 |
| 11 | 37 | | 2 | | | | 39 |
| 12 | 72 | | | | | | 72 |
| 13 | 35 | | | | | | 35 |
| 14 | 22 | | | | | | 22 |
| 15 | 57 | 1 | | | | | 58 |
| mean | 32.5 | 2.5 | 1 | .07 | 1.5 | 0.4 | 38.1 |

TABLE 2
SEEDLING DENSITY PER .1HA

| Plot | A.mag. | A.con. | P.mon. | P.lam. | P.c.mu. | T.mer. | TOTAL |
|---|---|---|---|---|---|---|---|
| 1 | 13 | | | | | | 13 |
| 2 | 10 | | | | | | 10 |
| 3 | 338 | | 16 | | | 2 | 356 |
| 4 | 38 | | | | | | 38 |
| 5 | 266 | | | | | | 266 |
| 6 | 541 | 2 | | | 60 | | 603 |
| 7 | 278 | 2 | | | | | 280 |
| 8 | 29 | 4 | | | | | 33 |
| 9 | 193 | 38 | | | | | 231 |
| 10 | 62 | | | | | | 62 |
| 11 | 119 | | | | | | 119 |
| 12 | 106 | | | | | | 106 |
| 13 | 54 | | | | | | 54 |
| 14 | 415 | | | | | | 415 |
| 15 | 43 | 1 | | | | | 44 |

TABLE 3

BASAL AREA ON .1HA PLOTS[1]

| Plot | A.mag. | A.con. | P.mon. | P.lam. | P.c.mu. | T.mer. | Total Ft.$^2$/acr |
|---|---|---|---|---|---|---|---|
| 1 | 84.96 | | | | | | 343.97 |
| 2 | 112.00 | | .89 | | | | 457.05 |
| 3 | 30.92 | | .34 | | | 2.65 | 137.28 |
| 4 | 79.76 | | 3.60 | | | | 337.48 |
| 5 | 50.40 | | 5.54 | | | | 218.38 |
| 6 | 203.76 | .11 | | | 1.02 | | 824.93 |
| 7 | 118.39 | | | | | | 479.32 |
| 8 | 42.86 | 46.74 | | | | | 362.77 |
| 9 | 97.89 | 14.18 | | .02 | | | 453.84 |
| 10 | 79.24 | | | | .44 | | 322.61 |
| 11 | 67.94 | | .40 | | | | 276.69 |
| 12 | 170.48 | | | | | | 690.22 |
| 13 | 123.84 | | | | | | 501.36 |
| 14 | 133.48 | | | | | | 540.39 |
| 15 | 110.95 | .001 | | | | | 449.19 |
| | | | | | | AVERAGE | 426.37 |

[1]individual species area in ft.$^2$/.1ha; total cover per plot converted to ft.$^2$/acre

TABLE 4

AVERAGE ELEVATIONS, TREE HEIGHTS, AND SNOW DEPTH OF RED FIR PLOTS[1]

| Plot | Mean Elev.[2] | Mean Tree Height[3] | Mean Snow Depth[4] |
|---|---|---|---|
| 1 | 6775 | 122 | 9.5 |
| 2 | 6815 | 116 | 10.4 |
| 3 | 6940 | 94 | 15.4 |
| 4 | 7055 | 91 | 11.9 |
| 5 | 6900 | 123 | 12.1 |
| 11 | 6530 | 132 | 9.8 |
| 12 | 6575 | 169 | 10.9 |
| 13 | 6575 | 155 | 12.5 |
| 14 | 6510 | 154 | 10.6 |
| 15 | 6305 | 134 | 7.8 |
| 6 | 5965 | 158 | 9.8 |
| 7 | 5990 | 145 | 9.5 |
| 8 | 6060 | 154 | 7.0 |
| 9 | 6175 | 163 | 8.8 |
| 10 | 6345 | 158 | 10.3 |

[1] measurements in feet
[2]estimated from the middle of plot
[3]taken from the five tallest trees
[4]taken from lichen to ground distance on five random trees

understory synusae but vary somewhat clinally in their tree species composition:

1) A xeric ridge-top or exposed slope, shallow soil, open forest which is characterized by the presence of mountain chaparral species in the shrub layer. White fir is a noticeable component at low elevations with Pinus monticola present at higher elevations.
2) An open forest with no shrub layer but with herbs in the Monardella-Chrysopsis union of Oosting and Billings (1943). Again there is a a clinal shift over elevation from A. concolor to P. monticola and Tsuga subdominance in the tree strata.
3) A closed forest with no shrub layer with the herb layer ranging from shade-tolerant,mesic meadow border species to more xeric ericaceous interior forest species. Lodgepole pine is present (as young trees primarily) in moist areas while P. monticola is occasionally present at high elevation sites.

Subtype 1 may be found at all elevations within the area. The most important prerequisite for this type is a shallow, well-drained soil underlain by granite slabs or boulders. For this reason, this type is frequently found on ridge-tops. Slope exposure is of secondary importance. This subtype is regularly found on all but North exposures and may even occasionally occur there when it spills over from a more exposed patch. The shrub understory varies from site to site and is also somewhat dependent on soil depth. Quercus vaccinifolia is the most widespread shrub and tends to prefer slightly deeper soils along with Chrysolepis sempervirens and Ceanothus velutinus. The two manzanitas, Arctostaphylos nevadensis and A. patula, on the other hand, will occur on only a thin veneer of soil overlying slabs of granite. These shrubs regularly form a near continuous cover under the widely spaced firs , but where there is an opening

of sterile decomposed granite herbs such as Arabis platysperma, Allium campanulatum, Penstemon laetus ssp. leptosepalus, P. neotericus, Gayophytum diffusum ssp. parviflorum, and Collinsia torreyi may occur. The shrubs also provide shelter for young trees and it is often the case that within taller patches of scrub there will be scattered established saplings of red and white fir.

There is no evidence that these open, shrubby understory woodlands are a result of previous fire. Very few fire scars were noted on the larger trees and stumps in this subtype and it may take many years of soil accumulation before a well developed fir forest covers these sites. Frequently where the soil becomes too uniformly shallow this subtype grades into mountain chaparral. The tree cover is usually sparse, developing in localized soil pockets, and varies elevationally from a near equal volume of red and white fir (ie. plot 8), through a zone of nearly pure red fir with an occasional sugar or Jeffrey pine to a zone of red fir with a small mixture of western white pine. White fir occasionally predominates very locally on the lowest and poorest sites in this type where winter snow is light, insolation high, and the soil is rocky. However, red fir regeneration nearly always exceeds white fir, and red fir is usually the dominant species over any area larger than 1ha.

The general lack of other more xerophytic conifers in this type such as P. jeffreyi may be due to the deep accumulation of snow and subsequent continual lodging of saplings. At lower elevations, or drier sites of similar exposure and elevation in the rain shadow of the Mt. Pleasant crest P. jeffreyi is a common forest constituent.

There are no clear boundaries between this shrubby understory type and the open herb understory type (type 2).Often a mat of mountain chaparral species will gradually give way to an open

understory dominated by light-loving herbs and subshrubs, but this nearly always appears to correspond with an increase in soil development (Fig. 7 ).

Subtype 2:

This is the most widespread type in the area and its herb component corresponds to Oosting and Billings (1943) Chrysopsis-Monardella union. This forest is also rather open, though usually somewhat more closed than the former type. It is characterized by a sparse to quite dense (Fig. 8) understory of xerophytic herbs and subshrubs with rarely any extensive growth of shrubs.

This type develops on slopes of all exposures and most degrees of steepness. All sites within this type are well drained, but have a somewhat deeper soil than type 1. There may be scattered boulders present, but these are separated by larger areas of soil with a light scattering of duff and fallen branches. In many places (as is true with type 1 also) this type might better be considered a woodland with large areas of only 45-50% crown cover. The presence of sunlight in the understory allows a number of herbs to grow and frequently these occur in dense, extensive patches.

In early summer four species of Lupinus, particularly L. adsurgens are conspicuous through large areas of open red fir forest. L. adsurgens is often the dominant herb over several hundred square meters and may grow so thickly as to preclude most other species. Other understory species common in this type are:

Monardella odoritissima ssp pallida
Lupinus sellulus
Lupinus andersonii
Lupinus obtusilobus
Kelloggia gallioides
Apocynum pumilum
Chrysopsis breweri
Collinsia torreyi
Castilleja applegatei
Collomia grandiflora
Erigeron inornatus
Eriogonum nudum var nudum
Hackelia nervosa
Hieracium albiflorum
Ipomopsis aggregata
Lithophragma breviloba
Sidalcea glaucescens
Silene lemmonii
Smilacina racemosa var. glabella
Stipa columbiana
Viola purpurea

FIGURE 7: Open, shrubby understory (type I) red fir forest giving way to herb-dominated understory (type 2) in forground

FIGURE 8: Type 2 red fir forest with dense understory of Lupinus adsurgens.

The open, herb dominated understory occasionally has individual shrubs from type 1 and mountain chaparral, particularly Quercus vaccinifolia. The shrubs most characteristic of the red fir forest according to Oosting and Billings are more or less limited to this type, but are locally rare. Both Symphoricarpos acutus and Ribes viscosissimum occur as scattered individuals only in the lower valley of the main fork of Mill Creek.

The successional status of this forest type is unclear. Open red fir forest in many locations is often thought to be in the over-mature stage (Oosting and Billings, 1943; Keeler-Wolf and Keeler-Wolf, 1973; Rundel et. al., 1977; McDonald and Church, 1979), but locally in most areas the trees do not appear senescent and there is a healthy recruitment of several age classes of young and medium-aged trees interspersed with the older dominant individuals (all plots but 6&14). Although there are the occasional crowded stands of young saplings so typical of red fir forest regeneration in other areas, the more common regeneration type is somewhat different. Rundel et. al. (1977) suggest that red fir usually only successfully regenerates when there are exceptionally heavy seed crops and these are few and far between. It appears that at Mt. Pleasant this may be one method of establishment, but the predominant type is of a less periodic nature with a moderate number of saplings and seedlings growing out of the vulnerable stages almost every year (see Appendix 3 for indication of uneven age of most plots). This may be a result of a more equitable climate with fewer severe droughts producing more regular seedling crops. Also because of rapid growth on the predominately southwestern exposures (Talley, 1977a&b) more saplings may be able to shoot rapidly above the average winter snow level. Snow blast at this level may inhibit the growing tip of slower growing saplings for many years

(Oosting and Billings,1943). Perhaps the openness of much of the Mt. Pleasant forest also has to do with the relative shallowness of the soil on most sites.

As with the first subtype, there is a gradual change in the subdominant trees from white fir at lower elevations to P. monticola at higher elevations with a broad belt of nearly pure red fir at the mid elevations. Although P. monticola is most widely distributed on the higher xeric ridges it is locally most abundant with the highest degree of regeneration on the North slope of Mt. Pleasant (see data in Appendix for plot 3). Here P. monticola is subdominant along with Tsuga mertensiana. The forest is open, with the understory still containing many of the herbs characteristic of this subtype but also including some localized species such as Poa epilis, Phyllodoce breweri, Ledum glandulosum, and the sedge Carex spectabilis. These species exist here because of a higher soil moisture content due to late melting of the heavy snowpack. Further down the Northeast side of the crest near the RNA boundary, extensive glaciated granite outcrops preclude development of any true forest and only scattered solitary P. monticola, A. magnifica, and P. jeffreyi occur

Subtype 3:

This is the classical closed red fir forest. It exists only on relatively deep soil, but not uniformly even there. The highest basal area groves are usually in a late stage of development with many individual trees over 90 cm dbh and few saplings or young trees (compared with other Sierra red fir studies however, there seems to be a higher representation of young and middle aged trees).

The understory is sparse and duff accumulation is usually high. Understory species in this type are all herbaceous and for the most part can be classified with Oosting and Billings' Pyrola-Corallorhiza union. They include; Pyrola picta, Corallorhiza maculata, Chimaphila

menziesii, and Pterospora andromedea, but also include some other species not mentioned in this union by Oosting and Billings: Phacelia hydrophylloides, Stellaria jamesiana, Polemonium californicum,Carex multicaulis, and Viola sheltonii.

The best development of this type is on gently sloping benches and flats. Here trees regularly attain girths of over 50" and heights of over 170 ft. Sample plots 1,2,6, and 12 are representative of this type.

The closed forests in mesic areas often have additional understory species such as Ligusticum grayi, Pyrola secunda, Lupinus polyphyllus, Pedicularis racemosa, Mitella breweri, and Osmorhiza chilensis frequently along with seedlings and saplings of Pinus contorta var. murrayana which rarely attain tree size (see plot 6).

Unlike the other red fir subtypes there is no shift from red and white fir codominance to a pure red fir composition. This is probably due to the deep soil and generally moist and sheltered conditions prevalent in this type. These are optimum conditions for red fir and even at the highest elevations P. monticola is not as important a constituent as it is in subtypes 1 and 2 for the same reasons (see plots 1&2).

Growth of red fir:

No extensive data was collected on growth rates of the local red firs. It is likely that the same general rules found in extensive investigations by Talley (1976, 1977b) also apply here. Fastest growth is likely to occur on open gentle South to West aspects and is slightly less for steep North aspects or exposed areas along ridges. Slowest growth may occur at the highest elevation sites on steep North exposures. In general Talley found growth much slower in dense groves. On the Bourland Meadow and Onion Creek candidate RNA's Talley

FIGURE 9: Type 3 red fir forest with lichen growth indicating winter snow depth of ca. 12'

FIGURE 10: Mountain chaparral at summit of Mt. Pleasant with Bucks Lake in background

found that it took between 36 and 80 years to attain breast height depending on exposure and forest density. At Mt. Pleasant the six saplings that were aged ( two from Northwest and four from Southwest exposures, all in subtype 2) indicate that on gentle sites red fir attains breast height in 28-37 years and will reach 12 ft. in another 30-32 years. This suggests that growth rates at Mt. Pleasant are rapid. It is also likely that most trees attain no great age throughout most of the area. One stump on the jeep road near the western boundary of the RNA had a diameter of 51" and an age of only ca 260 years. The oldest trees in the area probably occur on the high ridges and steep North slopes near the summit of Mt. Pleasant.

Mountain chaparral:

This shrub dominated community exists on slopes and ridges with very shallow soil throughout the area. The species that dominate this community are equally likely to occur at low or high elevation sites, showing no obvious altitudinal gradient. All species may exist on thin shells of soil overlaying granite bedrock. However, Quercus vaccinifolia, Chrysolepsis sempervirens, and Ceanothus velutinus appear to be more abundant in deeper soil or less exposed sites while Arctostaphylos nevadensis and A. patula often dominate on very shallow Southwest exposures. The most important member of the local mountain chaparral is Q. vaccinifolia, the huckleberry oak. It may occur in large nearly pure stands particularly on the Northeast escarpment.

Many herbs associated with mountain chaparral are shared with the open subtypes of red fir forest. There are only a few which seem to only occur here and they include: Arenaria congesta var. subcongesta, Calochortus leichtlinnii, Antennaria rosea, Carex exserta, and Senecio aronicoides.

The successional status of the local mountain chaparral is unlike

much of this community in California. Though much of the mtn. chaparral in the adjacent Bucks Lake Basin is clearly the result of extensive forest fires in the early half of this century, the local patches around Mt. Pleasant do not appear to be associated with past fires. The shallow ridgetop soil on which they typically occur apparently cannot support a more successionally advanced plant association. Typically the shrubs can only gain a foothold in the intervening narrow cracks and crevices in the large slabs and boulders. The scattered old and gnarled red and white firs within this community occur only in locally favorable areas, indicating the stability of these scrublands for well over 100 years in many cases.

Dry meadows:

Within the proposed RNA several large, dry,herb dominated areas of over one acre in size exist. These are usually near the heads of valleys above wet and moist meadow and mountain riparian areas and are often immediately adjacent to well developed red fir forest. It is difficult to arrive at an explanation for these dry openings. The substrate is always composed of rather deep unconsolidated deposits of decomposed granite. Although these excessively well-drained soils may pose difficulties for fir seedling establishment, there are similar areas where fir is colonizing or already established. Perhaps an additional factor precluding establishment of tree seedlings is that most of the dry openings have a North or Northwestern exposure, and many are on the lee side of a ridge. This suggests that snow may pile up in excessive quantities and last well into the summer at many of these locations. The combination of a long-lasting snow cover and excessively well drained, quick-drying soil may not allow a long enough period for suitable seedling establishment of

conifers or larger shrubs.

Regardless of the ecological factors associated with the maintenance of these "dry meadows" there is a distinct association of xerophytic herbs and subshrubs associated with them. Some species overlap from the adjacent open fir forests such as Chrysopsis breweri, Eriogonum nudum, Monardella odoratissima, Gayophytum ramosissimum, and Ipomopsis aggregata, but a number of species are more-or-less restricted to this relatively xeric habitat and include: Astragalus bolanderi, Calyptridium umbellatum, Castilleja payneae, Eriogonum umbellatum var. polyanthum, E. ursinum, Gayophytum diffusum ssp. parviflorum, Haplopappus bloomeri, Lupinus obtusilobus, Penstemon laetus ssp. leptosepalus, and Phlox diffusa.

In other reports on red fir habitat mention is usually made of similar dry meadows, suggesting that the necessary conditions prevail in a variety of locations for this community.

Rock outcrops:

Because of the local topography, the gentle southwestern slopes of Mt. Pleasant do not have many rock faces suitable for colonization. However, the steep cliffs and outcrops of the Northeast escarpment are riddled with crevices and crannies that support a number of herbs and shrubs, many of which are found nowhere else in the vicinity. Depending on the exposure of the rock faces these plants may be xerophytic or mesophytic. The following species are mesophytes found growing in shady crevices; Acer glabrum var. torreyi, Cryptogramma acrostichoides, Cystopteris fragilis, Heuchera rubescens var. glandulosa, Juncus nevadensis, Luzula divaricata, Phyllodoce breweri, Poa hansenii, Potentilla gracilis ssp. nuttallii, Primula suffrutescens Ribes nevadense, Saxifraga bryophora, Silene douglasii, and Spiraea densiflora.

On sunnier, drier exposures the following xerophytic species occur; Sedum obtusatum ssp. boreale, Zauschneria californica ssp. latifolia, Penstemon newberryi, P. deustus, Cheilanthes gracillima, Eriogonum lobbii, Streptanthus tortuosus var. orbiculatus, and Arenaria nuttallii ssp. fragilis.

## BOUNDARIES

The original boundaries proposed by Pass and Griggs (1975) and adhered to by McDonald and Church (1979) have been modified to include more of the northcentral and northeastern portions of section 10, the southcentral and southeastern portions of section 3, the southwestern quarter and portions of the southeastern quarter of section 2, and all of the northeastern quarter of section 11 (see map 1).

The primary rationale for extending the boundaries on the northern and northeastern edges was to include the summit and spur ridges of Mt. Pleasant and to include a sample of the unique community subtypes occurring on the Northeast escarpment. Only the high elevation forested slopes above 6700ft. contain Pinus monticola and locally Tsuga mertensiana, thus rounding out the species cline in red fir forest from low to high elevations within the Bucks Lake area. The Northeast escarpment houses several microhabitats such as the bench meadow, high elevation crevices and outcrops, and a subtype of mountain riparian vegetation which contain rare species not otherwise known from this vicinity.

The topographical boundaries along Mill Creek and the dividing ridge between the Westcentral and Central Branch of Mill Creek are reasonable and should be maintained.

# IMPACTS

## Cattle Grazing:

Without question the primary threat to the integrity of the area involves cattle grazing in the bogs, meadows, and riparian areas. We estimated the number of cattle within the area to be from 50 to 100 head throughout the summer of 1981. Although this does not seem to be a large number for an area of almost 2000 acres, almost all cattle grazing was concentrated in the 78 acres of bogs and meadows. In many cases it appeared that each meadow or meadow group had the same small herd tied to it for at least several days. Even a herd of five cattle within a small meadow-bog-riparian complex can be severely damaging by the end of the summer.

In the early summer the cattle are already cropping the flowering and fruiting tops of meadow herbs, sedges and grasses. It appears that due to the moist conditions of the forage, moist meadows and the edges of wet meadows bear the brunt of the grazing. However, in the late summer when forage in the moist meadows has dried or been largely cropped to the ground, the cattle then turn their attention to the bogs and wet meadows. Trampling these habitats alone, because of the saturated nature of the soil, can quickly turn them into muddy quagmires (Fig.11). The cattle's cutting hooves have damaged or destroyed a number of individuals of several species restricted to these saturated habitats, including some of the most interesting and rare species in the local flora (Fig. 12). Cattle trampling has apparently already exterminated one population of Drosera mapped by Pass et. al. (1975). The wet portion of the meadow (NW ¼ of SE ¼ sect. 10) which was said to contain the Drosera was found to be severely trampled when examined in September.

Grazing itself also takes its toll on several rare species.

FIGURE 11: Cattle impact on wet and adjacent moist meadow in early September

FIGURE 12: Cattle tracks on individuals of Drosera rotundifolia.

Menyanthes in particular seems to be a favorite with the cattle and they will wade into water 1 ft. deep to get to it (Fig.13 ).

By the late summer the moist meadows have dried and species such as Muhlenbergia filiformis have lost some of their footing in the now dry soil. This enables the cattle by their cropping action to actually pull up entire rooted tufts of grass. The remaining root tufts and their complementary holes often cover a moist meadow in early September.

Another serious problem in moist meadows involves the damage by cattle urine. Particularly noticeable in the early part of the summer are numerous small patches of brown vegetation in all moist meadows visited. Upon inspection (Fig.14 ) the affected plants appear to have been scorched and killed, much as if an application of herbicide was administered to them. Some of these patches were marked and revisited in September. From these observations, many species are apparently killed outright by the urine and only the toughest stoloniferous sedges and rushes appear to survive.

Obviously if the Mt. Pleasant RNA were of value simply for its red fir forest cattle grazing impacts would be fewer. Away from the moist habitats the cattle's influence is largely restricted to numerous criss-crossing trails and an occasional congregation area where dust is thick, ground vegetation absent, and flies numerous. However, there is evidence of cropping of species such as Lupinus adsurgens and Monardella even in the dry fir forest by late summer.

Because of the relatively gentle topography throughout the largest portion of the area cattle damage was found in every meadow. Only the small moist bench meadows on the steep Northeast escarpment were undisturbed.

One further detrimental factor attributable to the presence

FIGURE 13: Effects of cattle grazing on Menyanthes trifoliata in submerged bog in September

FIGURE 14: Cattle urine damage on plants of moist meadow in early September

of cattle is the very high population of biting flies in the area. Tabanids, Rhagionids, mosquitoes, and Ceratopogonids were extremely abundant for upper elevation Sierra habitats. This not only made for unpleasant working conditions, but could also be detrimental to certain animal species affected by diseases carried by these flies. Several dung-feeding and scavenging species were also present in great numbers.

Other Impacts:

1) Trails:

Apart from the numerous cattle trails that cross the terrain there are two major maintained trails entering the area. The California Riding and Hiking Trail traverses the southwestern edge of the RNA along Mill Creek and leads up the western flank of Mill Cr. valley to meet the Pacific Crest Trail just West of the Northwest corner of the area. The Pacific Crest Trail traverses the upper southwestern flanks of Mt. Pleasant and skirts the rim of the Northeast escarpment within the Northeast portion of the RNA. Both of these trails are for the most part not heavily used and no campsites or other human disturbances were found along the portions within the area. The California Riding and Hiking Trail along Mill Cr. is the most frequented, used mostly by fishermen walking in from the nearby road. However, litter and tree and shrub cutting are minimal even in this area. There seems to be no compelling reason to draw the boundary of the RNA at either of these trails.

2) Timber cutting:

Although a large timber sale was planned in the 1960's that would have affected almost the entire area, it was never advertised. The only impacts from this proposed sale are numerous faded blue spray-paint lines girdling the bases of trees throughout the RNA.

The only actual timber felling noted was restricted to two helicopter landing spots cleared in open forest in Sections 10 and 11. A total of six trees appeared to have been cut.

## RECOMMENDATIONS

Grazing as it is now is incompatible with an RNA status for Mt. Pleasant. It is our strong feeling that in order to maintain high scientific values all grazing should be halted within the RNA boundaries. Admittedly, this could create serious management problems. How could such a large area be economically fenced? How would the exclosure affect the surrounding unprotected land through increased grazing pressure there? Can the grazing lease be discontinued in this area? These and associated questions must be carefully considered.

If, and only if, it is totally unfeasible to discontinue grazing from the area, steps should be taken to at least greatly reduce it. We suggest the best way to do this would be to reduce the permitted number of cattle in the area by at least half the number that were present in the summer of 1981 and to fence off the most sensitive areas, namely the 10 bogs and associated wet meadows. It would not be enough to carry out only one of these actions. It would be absurd to designate the area an RNA without at least stopping the grazing in the bog areas. With the number of cattle present in 1981 it is likely that several Drosera and Menyanthes populations could be seriously reduced or extirpated within only a few years.

Aside from the grazing problem the area is relatively free from managerial problems. The existing network of cattle and human trails need not be improved or changed, and the human impact is not severe enough to require access limitations.

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# APPENDIX I
# VASCULAR PLANT LIST

This list includes all species we identified in the summer of 1981 plus a few species reported by Pass et al (1975). Nomenclature is from Munz. 1968 A California Flora and Supplement.

The following symbols refer to habitat types:

r=riparian
b=bog
wm=wet meadow
mm=moist meadow
bm=bench meadow
lp=lodgepole pine forest
rf 1=type 1 red fir forest
rf 2= type 2 red fir forest
rf 3=type 3 red fir forest
mc=mountain chaparral
dm=dry meadow
ro=rock outcrop

Actaea rubra: rare r
Abies concolor:rf 1&2 at elevations below 6400ft.
A. magnifica: rf 1,2,&3 scattered in all others except b
Acer glabrum var. torreyi: r, ro NE escarpment
Achillea lanulosa: mm
Aconitum columbianum: wm, r
Agrostis exarata: rf 2, mm
A. variabilis: bm, ro NE escarpment
Allium campanulatum: rf 1,2,mc
Alnus tenuifolia: r
Amelanchier pallida: lp uncommon along lower Mill Cr.
Angelica breweri: rf 2
Antennaria rosea: mc summit ridge
Apocynum medium:
A. pumilum: rf 1,2, mc
Aquilegia formosa: r
Arabis platysperma: rf 1,2 mc
Arceuthobium campylopodum: rf 1, 2, 3
Arctostaphylos nevadensis: mc rf 1, 2
A. patula: rf 1,2 and mc
Arenaria nuttallii ssp. fragilis: ro NE escarpment
Arenaria congesta var. subcongesta: mc summit ridge
Arnica diversifolia: bm and moist ro NE escarpment
Aster alpigenus ssp. andersonii: b, wm
A. campestris var. bloomeri: bm
A. elatus: mm lp
A. integrifolus : bm, mm upper elevations
Astragalus bolanderi: dm
Athyrium felix-femina: r
A. alpestre var. americanum: ro, r NE escarpment

Barbarea orthoceras: wm, r

Boisduvalia stricta: r
Boykinia major: r
Brodiaea lutea var. analina: mm, forest edges
Bromus orcuttianus: mm, rf 2
B. suskdorfii: rf 2

Calamagrostis canadensis: bm, mesic ro
Calochortus leichtlinnii: mc summit ridge
C. nudus: mm, lp, forest edge
Caltha howellii: wm
Calyptridium umbellatum: dm, rf 2
Camassia leichtlinnii ssp. suskdorfii: b, wm
Cardamine breweri: wm lower WC branch Mill Cr.
Carex angustior: b, wm
C. exserta: mc near summit
C. gymnoclada: wm, b
C. jonesii: wm, mm
C. limosa: b
C. multicaulis: rf 2, 3
C. rostrata: b, wm
C. senta: wm, b
C. sp.: Multiflorae or Vulpinae? b
C. spectabilis: bm, rf 2 on N slopes of Mt. Pleasant
Castilleja applegatei: rf 2, rf 1, mc
C. miniata: wm, r particularly on NE escarpment
C. lemmonii: b, wm usually hemiparisitic on Vaccinium
C. payneae: dm, rf 1, dry bench NE escarpment
Ceanothus velutinus: mc
Cheilanthes gracillima: xeric ro
Chimaphylla menziesii: rf 2,3
C. umbellata: reported in rf
Chrysolepsis sempervirens: mc
Chrysopsis breweri: rf 1,2,3 mc
Circea alpina var. pacifica: r
Claytonia lanceolata: reported in mm
Collinsia torreyi: mc, rf 1, 2,dm
Collomia grandiflora: rf 2
Cornus stolonifera: r
Cryptogramma acrostichoides: mesic ro
Cynoglossum occidentale: rf 2
Cystopteris fragilis: r, mesic ro

Delphinium depauperatum: mm, lp, forest edge-meadow border
D. nuttallianum: rf 2
Deschampsia elongata: mm
D. danthonoides: mm rf 2
D. caespitosa: wm, r
Dicentra uniflora: reported mm
Drosera rotundifolia: b in 10 locations
Dodecatheon alpinum ssp. majus: wm, r

Epilobium angustifolium: r
E. hornemanii: m
E. brevistylum: b, wm
E. glandulosum: m
E. oregonense: r, wm
E. lactiflorum: r, wm

Epilobium pringlianum: r
Eriogonum lobbii: xeric ro
E. nudum var. nudum: dm, rf 1, 2
E. umbellatum var. poylanthum: mc, xeric ro
E. ursinum: dm, mc
Erigeron inornatus: rf 1, 2
Erythronium purpurascens: wm, lp, forest edges

Galium bifolium: mm
G. trifidium var. subbiflorum: wm, r
Gayophytum diffusum ssp. parviflorum: dm
G. humile: dm rf 1,2
G. ramosissimum: dm, rf 1
Gilia capillaris: mm, lp
Glyceria elata: wm, r
Gnaphalium palustre: r disturbed areas

Habenaria dilatata var leucostachys: wm
H. sparsiflora: wm, r
Hackelia nervosa: rf 2
Haplopappus bloomeri: dm, rf 2
Heleocharis acicularis var. bella: b, wm
H. montividensis: b
Heuchera rubescens var. glandulosa: mesic ro
Hieracium albiflorum: rf 2
Horkelia fusca: mm
Hypericum anagaloides: wm, mm

Ipomopsis aggregata: rf 1,2, dm

Juncus nevadensis: mm, bm, mesic ro
J. parryi: mm

Kalmia polifolia var. macrophylla: wm, mm, r edges of lp
Kellogia galiodes: rf 1, 2

Ledum glandulosum var, californicum: mm, r, lp, moist rf 3
Leucothoe davisiae: reported
Lewisia nevadensis: mm
L. triphylla: mm
Libocedrus (Calocedrus) decurrens: rare lp lower Mill Cr.
Ligusticum grayi: mm, lp,
Lilium pardalinum: r
L. kelleyanum: reported r
Linanthus ciliatus: rf 2
Lithophragma breviloba: rf 2
L. parviflorum: reported
Lonicera conjugalis: r
Lupinus adsurgens var. undalatus: rf 2, 3 abundant
L. andersonii: rf 2
L. arbustus ssp. silvicola: reported
L. caudatus: reported
L. grayi: reported
L. obtusilobus: dm, rf 2
L. polyphyllus ssp. superbus: wm, mm, r, rf 3
L. sellulus:dm, rf 2
Luzula comosa: mm
L. subcongesta: mm
L. divericata: mesic ro, bm

Madia minima: mm
Menyanthes trifoliata: submerged b 5 locations
Microseris nutans: mm, lp
Microsteris gracilis: mm
Mimulus breweri: mm
M. guttatus: wm, r
M. lewisii: r
M. mephiticus: reported
M. moschatus var. mouliformis: mm, r
M. primuloides: mm, wm, b
M. p. var. pilosellus: b, wm less common than species
Mitella breweri: r, lp, rf 3
Monardella odoratissima ssp. pallida: rf 1, 2, dm
Montia chamissoi: r
Muhlenbergia filiformis: mm, wm
Narvarrettia divaricata: reported
Nuphar polysepalum: b submerged

Osmorhiza chilensis: rf 3, lp
O. occidentalis: rf 3, lp

Pedicularis attolens: wm, b
P. racemosa:mm, rf 3, lp
Penstemon deustus: xeric ro
P. laetus ssp. leocosepalus: dm, rf 2, mc
P. neotericus: mc, rf 1,2
P. newberryi: xeric ro
P. oreocharis: mm, lp
Perideridia bolanderi: mm
P. parishii: m
Phacelia mutabilis: rf 1, 2
P. hydrophylloides: rf 2,3
P. hastata: reported
P. procera: bm
Phlox diffusa: mc, xeric ro
Phyllodoce breweri: bm, rf 2 on N slope of Mt Pleasant
Pinus contorta var. murrayana: lp meadow edges, mesic rf 3
P. jeffreyi: rf 1, mc, xeric ro
P. lambertiana: rf 1, 2 low to mid elevations
P. monticola: rf 1, 2, 3 higher elevations
Poa epilis: bm, rf 2 NE escarpment
P. hansenii: bm, mesic ro
P. palustris: b, wm
Potemogeton natans: submerged b
Polemonium californicum: rf 2, 3 lp
Polygonum bistortoides: b, wm
P. douglasii: r disturbed
P. kelloggii: r, mm
P. phytolaccaefolium: r, moist ro
Populus tremuloides: r NE escarpment
Potentilla glandulosa ssp. nevadensis: mm
P. gracilis ssp. nuttallii: bm
P. drummondii: bm
Primula suffrutescens: mesic ro
Prunus emarginata: mesic ro, r
Pteridium aqualinum: mm, mesic rf 2
Pterospora andromedea: rf 2, 3

Pucinellia pauciflora: r
Pyrola picta: rf 2, 3
P. secunda: lp, rf 3, r

Quercus vaccinifolia: mc, rf 1,2

Ranunculus alismaefolius var. alismellus: wm, mm
R. aquatilus var. capillaceus: stream aquatic
Rhamnus alnifolia: r NE escarpment
Ribes nevadense: mesic ro
R. viscossimum var. hallii: rf 2
Rorippa curvisiliqua: r
Rubus parviflorus: rf 2,3 mesic
Rumex acetosella: mm

Sagina occidentalis: r, shady mm
Salix caudata: r
S. orestera: r
Sambucus caerula: reported
S. microbotrys: r, mesic ro
Saxifraga aprica: wm
S. bryophora: moist ro, bm.
S. oregana: wm
S. punctata ssp. arguta: moist ro NE escarpment
Scirpus congdoni: wm mm b
Sedum obtusatum ssp. boreale: xeric ro NE escarpment
Senecio aronicoides: mc
S. triangularis: r, wm, mm
Sidalcea glaucescens: rf 2
Silene douglasii: mesic ro near summit
S. lemmonii: rf 2
Sitanion hystrix: dm, mc near summit
Sorbus californicus: r, mesic ro
Smilacina racemosa var. glabra: mm, rf 2
Sparganium minimum: submerged b
Sphenosciadium capitellatum: wm
Spiraea douglasii: r, mm edges
S. densiflora: moist ro, r NE escarpment
Stachys rigida ssp rivularis: disturbed r, mm
Stellaria jamesiana: rf 3
Stephanomera lactucina: rf 1
Stipa columbiana: rf 2, mc
Streptanthus tortuosus var. orbiculatus: xeric ro
Symphoricarpus acutus: rf 2

Thalictrum fendleri: r
Trifolium longipes: mm, lp

Vaccinium occidentale: b, m edges
Veratrum californicum: mm, m
Veronica serpyllifolia var humifusa: mm, wm
Viola adunca: wm
V. glabella: r
V. macloskeyi: b, wm
V. sheltonii: rf 2, 3
V. purpurea: rf 2

Zauschneria californica ssp latifolia: xeric ro NE escarpment

# APPENDIX II

## VERTEBRATE LIST

## OF KNOWN OR SUSPECTED SPECIES

### FISH

Rainbow Trout (Salmo gairdneri); fairly common in Westcentral and main branch Mill Cr.

Brook Trout (Salvelinus fontinalis); common in both branches of Mill Cr. largest indivs. ca. 9"

### AMPHIBIANS

Southern Long-toed Salamander (Ambystoma macrodactylum sigillatum); of possible occurrence

California Newt (Taricha torosa); of possible occurrence

Ensatina (Ensatina eschscholtzi platensis); of possible occurrence

Western Toad (Bufo boreas ); common in boggy meadows

Pacific Tree Frog (Hyla regilla); very common bogs, lakes, wet meadows, and stream sides

California Red Legged Frog (Rana aurora draytoni); tadpoles seen in Blixie Lake

Mountain Yellow-legged Frog (Rana muscosa); fairly common in streams and in Dot Lake

### REPTILES

Western Fence Lizard (Sceloporus occidentalis); of possible occurrence at lower elevations

Sagebrush Lizard (Sceloporus graciosus); common in mountain chaparral

Western Skink (Eumeces skiltonianus); of possible occurrence

Northern Alligator Lizard (Gerrhonotus coeruleus); seen once in mtn. chaparral

Rubber Boa (Charina bottae); of possible occurrence

Ringneck Snake (Diadophis punctatus); of possible occurrence

Sharp-tailed Snake (Contia tenuis); of possible occurrence

Western Yellow-bellied Racer (Coluber constrictor); of possible occurrence

Pacific Gopher Snake (Pituophis melanoleucus catenifer); of possible occurrence

California Mountain Kingsnake (Lampropeltis zonata multicinta) of possible occurrence

Valley Garter Snake (Thamnophis sirtalis fitchi); boggy meadows and Dot Lake

Mountain Garter Snake (Thamnophis elegans elegans); of possible occurrence

Sierra Garter Snake (Thamnophis couchi couchi); of possible occurrence

Northern Pacific Rattlesnake (Crotalus viridis oreganus); of possible occurrence

BIRDS

This list includes only the species observed in the study area during visits in mid July and early September. The most notable absentee from the present list is the Hermit Warbler, a species that is characteristic of fir forest in California but not noticed here.

Mallard; a flock of 8 seen flying over crest and 2 seen on Blixie Lake Sept 2.

Goshawk; seen both visits valley of WC Branch Mill Cr.

Cooper's Hawk; soaring low over crest Sept.

Sharp-shinned Hawk; soaring over meadow WC Branch Mill Cr. Sept.

Red-tailed Hawk; seen both visits, widespread

Mountain Quail; one family seen mid elevations mtn chaparral

Band-tailed Pigeon; several seen in July

Great Horned Owl; heard every night in Sept. at low elevations

Great Gray Owl; seen and heard at low elevations on both visit

Common Nighthawk; flying over Mill Cr. at dusk in July

Rufous (?) Hummingbird; seen feeding at Ipomopsis in dry meadows in July

Red-shafted Flicker; common particularly in Sept.

Pileated Woodpecker; seen and heard on both visits at lower elevations

White-headed Woodpecker; uncommon resident

Red-breasted Sapsucker; uncommon resident of lodgepole forest along lower Mill Cr.

Hairy Woodpecker; Fairly common

Hammond's Flycatcher; open to closed red fir forest July and Sept.

Dusky Flycatcher; open fir and mtn. chaparral July

Western Wood Pewee; common July uncommon Sept. in valleys and meadow borders

Olive-sided Flycatcher; uncommon July

Violet-green Swallow; overhead July

Stellar's Jay; common resident

Mountain Chickadee; very common resident

Dipper; one individual seen both visits along lower Mill Cr.

White-breasted Nuthatch; uncommon fir forest Sept.

Red-Breasted Nuthatch; very common resident

Brown Creeper; common July, very common Sept.

House Wren; uncommon July

Winter Wren; breeding in dense red fir and adjacent riparian areas WC branch Mill Cr. July

Rock Wren; rock outcrops and talus NE escarpment July

Robin; common in forests and moist & wet meadows July & Sept.

Townsend's Solitare; fairly common at high elevations near Mt. Pleasant crest July & Sept.

Hermit Thrush; fairly common throughout red fir forest July uncommon Sept.

Golden-crowned Kinglet; very common resident

Ruby-crowned Kinglet; uncommon in lodgepole forest along lower Mill Cr. July

Solitary Vireo; fairly common up-mountain visitor and Possib. breeder July

Warbling Vireo; common around low elevation riparian habitat July

Orange-crowned Warbler; common up-mountain visitor July

Nashville Warbler; Very common up-mountain visitor July

Yellow-rumped (Audubon's) Warbler; very common breeder July less common Sept.

MacGillivray's Warbler; uncommon in riparian and mtn. chaparral in July and Sept.

Wilson's Warbler; fairly common July riparian

Brown-headed Cowbird: uncommon meadows July

Western Tanager; fairly common July uncommon Sept.

Black-headed Grosbeak; uncommon up-mountain visitor July

Evening Grosbeak; common in fir forest in July , uncommon Sep

Cassin's Finch; common July and Sept.

Pine Siskin; common July and Sept.

Red Crossbill; uncommon July and Sept.

Green-tailed Towhee; uncommon in mtn. chaparral on Mt Pleasant crest and NE escarpment

Dark-eyed (Oregon) Junco; very common July and Sept.

Chipping Sparrow: fairly common July

Fox Sparrow: common July, uncommon Sept.

Lincoln's Sparrow; fairly common July in wet meadows and riparian areas

MAMMALS

Dusky Shrew ( Sorex obscurus); of possible occurrence

Vagrant Shrew (Sorex vagrans); of possible occurrence

Water Shrew (Sorex palustris); of possible occurrence

Trowbridge Shrew (Sorex trowbridgii); of possible occurrence

Broad-handed Mole (Scapanus latimanus); apparently common, moist meadows and forest edges

Little Brown Bat (Myotis lucifugus); of possible occurrence

Fringed Myotis (Myotis thysanodes); of possible occurrence

California Myotis (Myotis californicus); of possible occurrence

Long-eared Myotis (Myotis evotis); of possible occurrence

Yuma Myotis (Myotis yumanensis); of possible occurrence

Silvery-haired Bat (Lasionycteris noctivagans); seen commonly in July over lower Mill Cr.

Big Brown Bat (Eptescius fuscus); of possible occurrence

Snowshoe Hare (Lepus americanus); of possible occurrence

Mountain Beaver (Aplodontia rufa); of possible occurrence

Golden-mantled Ground Squirrel (Callospermophilus lateralis); common mtn chaparral & open fir

Yellow Pine Chipmunk (Eutamias amoenus); possibly occurs

Lodgepole Chipmunk (Eutamias speciosus); common fir forests

Long-eared Chipmunk (Eutamias quadrimaculatus); seen in mtn. chaparral

Townsend's Chipmunk (Eutamias townsendii); possibly occurs

Douglas Squirrel (Tamiasciurus douglasii); common fir forests

Northern Flying Squirrel (Glaucomys sabrinus); common fir forests, strictly nocturnal

Mountain Pocket Gopher (Thomomys monticola) common meadows to summit fir forests

Beaver (Castor canadensis); introduced in upper drainage of Mill Cr. West of RNA

Western Harvest Mouse (Reithrodontomys megalotis); possible

Deer Mouse (Peromyscus maniculatus); very common. The only species captured regularly in live traps set at low elevation along Mill Cr. in Sept.

Bushy-tailed Wood Rat (Neotoma cinerea); scats seen on NE escarpment

Heather Vole (Phenacomys intermedius); possibly occurs

Long-tailed Meadow Mouse (Microtus longicaudatus); trails in meadows and riparian

Western Jumping Mouse (Zapus princeps); possibly occurs

Porcupine (Erethizon dorsatum); scats and bark gnawing in lodgepole forest Mill Cr.

Red Fox (Vulpes fulva); of possible occurrence

Coyote (Canis latrans); heard regularly and scats seen on both visits

Black Bear (Ursus americanus); scats commonly seen

Raccoon (Procyon lotor); tracks seen along lower Mill Cr.

Marten (Martes americana); of possible occurrence

Fisher (Martes pennanti); of possible occurrence

Mink (Mustella vison); of possible occurrence

Ermine (Mustella erminea); of possible occurrence

Long-tailed Weasel (Mustella frenata); of possible occurrence

Wolverine (Gulo luscus); of possible occurrence

Striped Skunk (Mephitis mephitis); of possible occurrence

Mountain Lion (Felis concolor); tracks seen on both visits

Bobcat (Lynx rufus); of possible occurrence

Mule Deer (Odocoileus hemionus); commonly seen on both visits

# APPENDIX III

## VEGETATION PLOT DESCRIPTIONS

PLOT 1: 6740-6800 ft. W exposure, 15-20° slope, sparse herb understory

| dbh" | # A.mag. |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 5 |
| 4 | 1 |
| 5 | 1 |
| 6 | 1 |
| 11 | 1 |
| 14 | 2 |
| 19 | 1 |
| 20 | 1 |
| 21 | 2 |
| 22 | 2 |
| 27 | 1 |
| 29 | 2 |
| 30 | 1 |
| 33 | 2 |
| 36 | 1 |
| 41 | 1 |
| 42 | 1 |
| 45 | 1 |
| total | 30 |

herbs present: Corallorhiza maculata, Monardella odoratissima, Stellaria jamesiana, Chrysopsis breweri

PLOT 2: 6800-6830 ft. WSW exposure 10-15° slope, sparse herb understory

| dbh" | # A.Mag. | # P. mon. |
|---|---|---|
| 8 | 1 | 1 |
| 10 | 1 | 1 |
| 13 | 1 | |
| 14 | 1 | |
| 18 | 1 | |
| 19 | 1 | |
| 20 | 3 | |
| 26 | 3 | |
| 27 | 1 | |
| 28 | 3 | |
| 29 | 1 | |
| 30 | 1 | |
| 31 | 5 | |
| 32 | 1 | |
| 34 | 1 | |
| 37 | 2 | |
| 39 | 1 | |
| total | 28 | 2 |

herbs present: Pterospora andromedea, Corallorhiza maculata

PLOT 3: 6900-6980 ft. due N exposure. Slope 40-45° open, sparse forest. Herbs fairly dense

| dbh" | # A.mag. | #P.mon. | # T.mer. |
|---|---|---|---|
| 1 | | 1 | 1 |
| 2 | | 1 | |
| 3 | | 2 | |
| 4 | | 1 | |
| 5 | | 1 | |
| 7 | | | 1 |
| 8 | | | 1 |
| 9 | 1 | | 1 |
| 11 | | | 1 |
| 13 | | 1 | 1 |
| 17 | 1 | | |
| 22 | 1 | | |
| 25 | 1 | | |
| 27 | 1 | | |
| 32 | 2 | | |
| 38 | 1 | | |
| totals | 8 | 6 | 6 |

herbs present: Penstemon newberryi, Chrysopsis breweri, Luzula divaricata, Poa epilis, Sitanion hystrix, Carex spectabilis, Phyllodoce breweri

PLOT 4: 7050-7060 ft. S exposure 5-10° slope. N end open, S end closed forest. Understory sparse.

| dbh" | # A. mag. | # P. mon. |
|---|---|---|
| 10 | 1 | |
| 11 | | 1 |
| 12 | 1 | |
| 13 | 1 | |
| 14 | | 1 |
| 19 | 1 | 1 |
| 20 | 1 | |
| 23 | 1 | |
| 24 | 1 | |
| 27 | 1 | |
| 28 | 1 | |
| 29 | 1 | |
| 30 | 1 | |
| 33 | 2 | |
| 34 | 1 | |
| 35 | 1 | |
| 36 | 1 | |
| 40 | 1 | |
| 41 | 1 | |
| totals | 18 | 3 |

shrubs and herbs present: Arctostaphylos nevadensis, Apocynum pumilum Pterospora andromedea, Corallorhiza maculata

PLOT 5: 6895-6905 ft. WSW exposure. 5-10° slope fairly thick duff, few herbs

| dbh | # A.mag. | # P.mon. |
|---|---|---|
| 1 | 1 | |
| 2 | 1 | |
| 3 | 1 | |
| 4 | | 2 |
| 6 | 1 | |
| 8 | 2 | |
| 11 | 1 | |
| 15 | | 1 |
| 17 | 1 | |
| 20 | 1 | 1 |
| 28 | 1 | |
| 31 | 1 | |
| 34 | 2 | |
| 35 | 1 | |
| 41 | 1 | |
| total | 16 | 4 |

herbs present: Apocynum pumilum, Arabis platysperma, Phacelia hydrophylloides, Pterospora andromedea

PLOT 6: 5950-5960 ft. SSE exposure gradual 2-5° slope. Soil deep and moist. Herbs numerous. fairly even-aged

| dbh | #A.mag. | #A.con. | #P.c.m |
|---|---|---|---|
| 1 | | | 9 |
| 2 | 3 | | 7 |
| 3 | 1 | | 3 |
| 4 | | | 1 |
| 5 | | 1 | |
| 6 | 1 | | |
| 8 | 1 | | |
| 9 | 1 | | |
| 11 | | | 1 |
| 30 | 1 | | |
| 31 | 1 | | |
| 35 | 1 | | |
| 37 | 1 | | |
| 39 | 3 | | |
| 42 | 2 | | |
| 46 | 1 | | |
| 48 | 1 | | |
| 49 | 1 | | |
| 50 | 1 | | |
| 51 | 1 | | |
| 52 | 1 | | |
| 56 | 1 | | |
| 57 | 1 | | |
| 61 | 1 | | |
| total | 25 | 1 | 21 |

herbs present: Ligusticum grayi, Lupinus polyphyllus, Pedicularis racemosa, Polemonium californicum, Lupinus adsurgens

PLOT 7: 5980-6000 ft. ESE exposure. Crown cover dense duff heavy. 5-10° slope herb cover sparse.

| dbh" | #A. mag. |
|---|---|
| 1 | 2 |
| 2 | 5 |
| 3 | 4 |
| 5 | 2 |
| 6 | 1 |
| 7 | 3 |
| 8 | 3 |
| 11 | 2 |
| 13 | 3 |
| 16 | 1 |
| 18 | 2 |
| 19 | 1 |
| 22 | 1 |
| 29 | 1 |
| 31 | 1 |
| 37 | 1 |
| 44 | 1 |
| 46 | 3 |
| 49 | 1 |
| 51 | 1 |
| 52 | 1 |
| total | 41 |

herbs present: Lupinus adsurgens, Pedicularis racemosa, Chrysopsis breweri, Chimaphylla menziesii, Pyrola secunda, Polemonium californicum

PLOT 8: 6040-6080 ft. due S exposure open forest with scattered shrubs and herbs. 30° slope shallow soil

| dbh" | #A. mag. | #A. con. |
|---|---|---|
| 1 | 1 | 1 |
| 2 | 4 | |
| 3 | 3 | |
| 4 | 1 | |
| 17 | 1 | |
| 19 | | 1 |
| 22 | 1 | |
| 23 | | 2 |
| 27 | 1 | |
| 28 | 1 | |
| 29 | 1 | |
| 30 | | 1 |
| 33 | | 2 |
| 34 | 1 | 1 |
| 41 | 1 | |
| 43 | 1 | |
| 54 | | 1 |
| totals | 17 | 9 |

herbs and shrubs present: Arctostaphylos patula, A. nevadensis, Quercus vaccinifolia, Lupinus adsurgens, Arabi platysperma, Gayophytum humile, Monardella odoratissima, Pyrola picta

PLOT 9: 6150-6200 ft. SE exposure. 25° slope, moderately deep soil with scattered boulders. Herbs numerous, moderately open canopy

| dbh" | #A.mag. | #A.con | #P.lam. |
|---|---|---|---|
| 1 | 8 | 4 | |
| 2 | 3 | 6 | 1 |
| 3 | 3 | 11 | |
| 4 | 2 | 1 | |
| 5 | 1 | 1 | |
| 6 | 1 | 1 | |
| 14 | 1 | | |
| 15 | 1 | | |
| 26 | 1 | 1 | |
| 28 | 1 | | |
| 30 | 1 | | |
| 33 | 1 | | |
| 34 | 1 | | |
| 37 | 1 | | |
| 38 | 1 | | |
| 39 | 1 | | |
| 42 | | 1 | |
| 47 | 1 | | |
| 58 | 1 | | |
| 60 | 1 | | |
| totals | 31 | 26 | 1 |

herbs present: Pteridium aqualinum, Lupinus adsurgens, Monardella odoratissima, Chimaphylla menziesii, Hieracium albiflorum, Pyrola picta

PLOT 10: 6330-6360 ft. Due E exposure. Slope 5-15° mesic meadow border on E, closed canopy on W Soil moderately deep except W end. Herbs sparse

| dbh" | #A.mag. | #P.c.mu. |
|---|---|---|
| 1 | 1 | |
| 2 | 4 | |
| 3 | 5 | |
| 4 | 4 | |
| 5 | 6 | |
| 6 | 3 | |
| 7 | 1 | |
| 8 | 2 | |
| 9 | 3 | 1 |
| 11 | 2 | |
| 12 | 1 | |
| 14 | 2 | |
| 17 | 6 | |
| 18 | 5 | |
| 21 | 1 | |
| 25 | 1 | |
| 26 | 2 | |
| 40 | 1 | |
| 54 | 1 | |
| 59 | 1 | |
| totals | 52 | 1 |

herbs present: Lupinus adsurgens, Aster elatus, Monardella odoratissima Chrysopsis breweri, Phacelia hydrophyloides

PLOT 11: 6520-6540 ft. NNW exposure. Slope 5-35° mostly gentle. S end has pitched granite slabs & shallow soil, N 2/3rds gentle slope & deeper soil. Open in S w/ dry meadow edge, denser in N

| dbh" | #A. mag. | #P. mon. |
|---|---|---|
| 1 | 1 | |
| 2 | 1 | |
| 3 | 4 | |
| 4 | 3 | |
| 5 | 4 | 1 |
| 6 | 4 | |
| 7 | | 1 |
| 9 | 5 | |
| 10 | 1 | |
| 11 | 1 | |
| 15 | 1 | |
| 16 | 2 | |
| 21 | 1 | |
| 24 | 1 | |
| 25 | 1 | |
| 26 | 3 | |
| 28 | 1 | |
| 33 | 1 | |
| 60 | 1 | |
| totals | 35 | 2 |

herbs present: Monardella odoratissima, Chrysopsis breweri, Eriogonum ursinum, Lupinus obtusilobus, L. adsurgens, Calyptridium umbellatum, Collinsia torreyi, Stipa columbiana, Phacelia hydrophylloides

PLOT 12: 6550-6600 ft. WSW exposure Slope 15-20°. Dense old growth in center w/ dry meadow edge and younger trees on edges. Soil moderately deep except E end.

| dbh" | #A. mag. |
|---|---|
| 1 | 7 |
| 2 | 4 |
| 3 | 2 |
| 4 | 7 |
| 5 | 6 |
| 6 | 8 |
| 7 | 7 |
| 8 | 2 |
| 10 | 1 |
| 11 | 1 |
| 13 | 2 |
| 15 | 1 |
| 17 | 2 |
| 18 | 3 |
| 19 | 5 |
| 24 | 2 |
| 25 | 1 |
| 26 | 2 |
| 31 | 1 |
| 44 | 2 |
| 49 | 1 |
| 50 | 1 |
| 51 | 1 |
| 54 | 1 |
| 65 | 1 |
| 67 | 1 |
| total | 72 |

herbs present: Chrysopsis breweri, Lupinus adsurgens, Monardella odoratissima, Collinsia torreyi, Phacelia hydrophylloides

PLOT 13: 6550-6600 ft. NNE exposure. Slope 10-15°. Soil relatively deep mostly closed w/ small openings on N and middle Polemonium very common

| dbh" | #A. mag. |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 1 |
| 4 | 1 |
| 5 | 3 |
| 7 | 1 |
| 8 | 2 |
| 9 | 1 |
| 12 | 2 |
| 13 | 2 |
| 14 | 2 |
| 15 | 1 |
| 16 | 2 |
| 17 | 1 |
| 19 | 2 |
| 20 | 1 |
| 27 | 1 |
| 35 | 1 |
| 40 | 1 |
| 41 | 1 |
| 42 | 2 |
| 48 | 1 |
| 50 | 1 |
| 52 | 1 |
| 55 | 1 |
| total | 35 |

herbs present: Polemonium californicum, Monardella odoratissima, Collinsia torreyi, Chrysopsis breweri, Agrostis variabilis

PLOT 14: 6500-6520 ft. Due S exposure. More even aged than most stands. Closed canopy except N end. Slope 15-20° soil moderately deep. Herbs fairly sparse, abundant seedlings-

| dbh" | #A. mag. |
|---|---|
| 2 | 1 |
| 3 | 1 |
| 5 | 1 |
| 6 | 1 |
| 32 | 2 |
| 33 | 2 |
| 34 | 2 |
| 35 | 1 |
| 36 | 4 |
| 37 | 3 |
| 38 | 1 |
| 39 | 1 |
| 44 | 1 |
| 45 | 1 |
| total | 22 |

herbs present: Lupinus adsurgens, Monardella odoratissima, Pyrola pic Sidalcea glauca, Pteridium aqualinu